WHAT IS CLAIMED IS:

1. An optical amplifier comprising:

an optical amplification medium;

an excitation source to stimulate the amplification medium to output at least one wavelength gain peak; and

a gain equalizer to equalize the output of the amplification medium such that gain is produced at wavelengths other than the wavelength gain peak.

2. An optical amplifier according to claim 1, wherein the gain equalizer attenuates gain at the peak wavelength.

3. An optical amplifier according to claim 1, wherein the gain equalizer equalizes the output of the amplification medium such that nearly even gain is produced at wavelengths shorter than the wavelength gain peak.

4. An optical amplifier according to claim 1, further comprising:

a variable attenuator, and

automatic level control circuitry to monitor at least one of the input of the optical amplifier and the output of the optical amplifier and maintain the output level of the optical amplifier at a substantially constant level.

5. An optical amplifier according to claim 1, wherein the optical amplification medium is segmented and comprises a plurality of amplification medium structures which together produce at least one wavelength gain peak when stimulated by the excitation source.

6. An optical amplifier according to claim 5, wherein the amplification medium structures are semiconductor optical amplifiers.

7. An optical amplifier according to claim 5, wherein the gain equalizer comprises a plurality of gain equalizer segments, which together produce gain at wavelengths other than the wavelength gain peak.

8. An optical amplifier according to claim 7, wherein the gain equalizer segments are positioned with amplification medium structures positioned therebetween.

9. An optical amplifier according to claim 7 wherein

the excitation source stimulates the amplification medium with pumping light having a pumping wavelength, and

the gain equalizer segments are substantially transparent to the pumping wavelength.

10. An optical amplifier according to claim 1, wherein the optical amplification

medium is doped with at least one rare earth element.

11. An optical amplifier according to claim 10, wherein

the excitation light source stimulates the optical amplification medium to achieve a population inversion ratio having a positive throughout an optical gain signal wavelength band,

the wavelength gain peak is outside of the optical signal wavelength band, and

the gain equalizer attenuates the wavelength gain peak.

12. An optical amplifier according to claim 1, wherein the optical amplification medium has an input and an output, the optical amplifier further comprising a feedback loop to the excitation source, to monitor the input and the output of the amplification medium and maintain a substantially constant gain within the amplification medium over time.

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13. An optical amplifier according to claim 1, wherein the optical amplification medium has an input and an output, the optical amplifier further comprising:

monitors located at the input and output of the amplification medium to provide feedback; and

an automatic gain control circuit connected to the monitors to control the excitation source so as to maintain a substantially constant population inversion ratio within the amplification medium over time.

14. An optical amplifier according to claim 1, further comprising a resonator, the optical amplification medium being located within the resonator.

15. An optical amplifier according to claim 14, wherein
the optical amplification medium has an input and an output, and
the resonator comprises:
a pair of mirrors that reflect a selected wavelength; and
optical couplers provided at the input and the output of the amplification medium to divert a portion of the light emitted from the optical amplification medium to the mirrors.

16. An optical amplifier according to claim 15, wherein the optical couplers are 9:1 couplers.

17. An optical amplifier according to claim 15, wherein the mirrors are fiber grating mirrors.

18. An optical amplifier according to claim 15, wherein the gain equalizer is substantially transparent to the selected wavelength.

19. An optical amplifier according to claim 15, wherein

the selected wavelength reflected by the mirrors is within a signal band used for optical signals to be amplified, and

no optical signal is transmitted at the selected wavelength.

20. An optical amplifier according to claim 1, wherein the excitation source causes excited emission within the amplification medium.

21. An optical amplifier according to claim 1, wherein the optical amplification medium comprises:

a cladding;

a doped core provided interior to the cladding; and

gratings provided within the highly doped core.

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22. An optical amplifier according to claim 21, wherein the core is highly doped.

23. An optical amplifier according to claim 21, wherein the gratings provided within the doped core serve as the gain equalizer.

24. An optical amplifier according to claim 21, wherein the gratings are long-period gratings.

25. An optical amplifier device, comprising:

an amplification medium comprising at least one erbium doped fiber;

an excitation light source to produce a population inversion ratio of about 0.7 to about 1.0 within the amplification medium; and

a gain equalizer to obtain substantially identical wavelength characteristics for a wavelength band of from about 1490 nm to about 1530 nm.

26. An optical amplifier device, comprising:

an amplification medium comprising at least one erbium doped fiber;

an excitation light source to produce a population inversion ratio of about 0.8 to about 1.0 within the amplification medium; and

a gain equalizer to obtain substantially identical wavelength characteristics for a wavelength band of from about 1450 nm to about 1490 nm.

27. An optical amplifier device, comprising:

an amplification medium comprising at least one erbium doped fiber;

an excitation light source to produce a population inversion ratio of about 0.3 to about 1.0 within the amplification medium; and

a gain equalizer to obtain substantially identical wavelength characteristics for a wavelength band of from about 1610 nm to about 1650 nm.

28. An optical amplification method, comprising:

selecting a population inversion ratio to achieve positive gain throughout an optical signal wavelength band;

exciting the amplification medium to the selected population inversion ration to produce a wavelength gain peak at a wavelength outside of the optical signal wavelength band;

equalizing the gain to achieve substantially uniform gain over the optical signal wavelength band; and

attenuating amplification in wavelength bands outside of the optical signal wavelength band.

29. An optical amplification method according to claim 28, wherein the optical signal wavelength band is at wavelengths less than the wavelength of the wavelength gain peak for the amplification medium.

30. An optical amplifier comprising:

a WDM splitter to separate first and second different optical signal wavelength bands;

an optical amplification device for the first wavelength optical signal band, comprising:

a first amplification medium;

an excitation light source to produce a first population inversion ratio within the first amplification medium; and

a gain equalizer to obtain substantially uniform gain over the first optical signal

wavelength band;

an optical amplification device for the second wavelength band, comprising:

a second amplification medium; and

an excitation light source to produce a second population inversion ratio within the second amplification medium, the first and second population inversion ratios being different; and

a WDM coupler to recombine the first and second optical wavelength bands after amplification.

31. An optical amplifier according to claim 30, wherein the first population inversion ratio is less than the second population inversion ratio.

32. An optical amplifier according to claim 31, wherein

the first and second optical amplification mediums each comprise at least one rare earth element doped optical fiber, and

the length of the at least one rare earth element doped optical fiber for the first amplification medium is greater than that for the second amplification medium.

33. An optical amplifier according to claim 30, wherein

the first amplification medium has a wavelength gain peak, and

the wavelength gain peak is outside of the first optical signal wavelength band.

34. An optical amplifier according to claim 30, wherein the WDM splitter separates first, second and third different optical signal wavelength bands, the optical amplifier further comprising an optical amplification device for the third wavelength band.